

CLAIMS

[1]           A method of separating and recovering an acid/sugar solution and a lignophenol derivative,  
5   comprising putting a reaction mixture of a lignocellulosic material, a phenol derivative and an acid into an amount of water 0.5 to 6 times the amount of the mixture as a volume ratio, and leaving to stand or maintaining a weakly agitated state, so as to agglomerate a lignophenol  
10   derivative produced as a solid phase, and then carrying out solid-liquid separation, so as to separate and recover the solid-phase lignophenol derivative and a liquid-phase acid/sugar solution.

[2]           The method according to claim 1, wherein the  
15   reaction mixture of the lignocellulosic material, the phenol derivative and the acid is diluted with an amount of water substantially the same as the amount of the reaction mixture as a volume ratio.

[3]           The method according to claim 1 or 2, wherein the  
20   solid-liquid separation is carried out using a filtration apparatus.

[4]           The method according to any of claims 1 through 3, wherein the acid/sugar solution recovered as the liquid phase through the solid-liquid separation is further  
25   subjected to second solid-liquid separation so as to remove residual SS as a solid phase.

[5]           The method according to any of claims 1 through 4, wherein lignophenol derivative-containing solid matter

recovered as the solid phase through the solid-liquid separation is further subjected to third and fourth dispersion in water and solid-liquid separation, whereby the recovery rate for the acid and the sugar in the reaction mixture of the lignocellulosic material, the phenol derivative and the acid is improved.

[6]           The method according to claim 5, wherein a liquid phase obtained from the third solid-liquid separation and/or the fourth solid-liquid separation is used as diluting water to be put into the reaction mixture of the lignocellulosic material, the phenol derivative and the acid is put.

[7]           An apparatus for recovering an acid/sugar solution, comprising: an aqueous dilution tank that receives water, and has means for putting a reaction mixture of a lignocellulosic material, a phenol derivative and an acid into the water; a first solid-liquid separation apparatus that receives the diluted reaction mixture, and is for carrying out solid-liquid separation so as to separate off a lignophenol derivative as a solid phase; and a second solid-liquid separation apparatus for further carrying out solid-liquid separation treatment on a liquid phase recovered from the first solid-liquid separation apparatus so as to separate out residual SS as a solid phase.

[8]           An apparatus for recovering an acid/sugar solution, comprising: an aqueous dilution tank that receives water, and has means for putting a reaction

mixture of a lignocellulosic material, a phenol derivative and an acid into the water; a first solid-liquid separation apparatus that receives the diluted reaction mixture, and is for carrying out solid-liquid separation so as to  
5 separate off a lignophenol derivative as a solid phase; a standing tank for leaving a liquid phase recovered from the first solid-liquid separation apparatus to stand; and a second solid-liquid separation apparatus that receives liquid from the standing tank, and is for further carrying  
10 out solid-liquid separation treatment so as to separate out residual SS as a solid phase.

[9] An apparatus for recovering a lignophenol derivative and an acid/sugar solution, comprising: an acid treatment/aqueous dilution tank that receives a phenol  
15 derivative-impregnated lignocellulosic material, and has means for adding an acid to the lignocellulosic material, and means for putting diluting water into a reaction mixture containing the lignocellulosic material on which acid treatment has been carried out through the addition of  
20 the acid; a first solid-liquid separation apparatus that receives the diluted reaction mixture, and is for carrying out solid-liquid separation so as to separate off a lignophenol derivative as a solid phase; a second solid-liquid separation apparatus for further carrying out solid-  
25 liquid separation treatment on a liquid phase recovered from the first solid-liquid separation apparatus so as to separate out residual SS as a solid phase; an agitating tank that receives the solid matter recovered through the

first solid-liquid separation, and is for adding water to the solid matter and agitating; and a third solid-liquid separation apparatus that receives an aqueous slurry recovered from the agitating tank, and is for carrying out solid-liquid separation.

[10] An apparatus for recovering a lignophenol derivative and an acid/sugar solution, comprising: an acid treatment/aqueous dilution tank that receives a phenol derivative-impregnated lignocellulosic material, and has means for adding an acid to the lignocellulosic material, and means for putting diluting water into a reaction mixture containing the lignocellulosic material on which acid treatment has been carried out through the addition of the acid; a first solid-liquid separation apparatus that receives the diluted reaction mixture, and is for carrying out solid-liquid separation so as to separate off a lignophenol derivative as a solid phase; a second solid-liquid separation apparatus for further carrying out solid-liquid separation treatment on a liquid phase recovered from the first solid-liquid separation apparatus so as to separate out residual SS as a solid phase; a crushing apparatus that receives the solid matter recovered through the first solid-liquid separation, and is for crushing the solid matter; an agitating tank for adding water to the crushed solid matter and agitating; and a third solid-liquid separation apparatus that receives an aqueous slurry recovered from the agitating tank, and is for carrying out solid-liquid separation.

[11]        An apparatus for recovering a lignophenol derivative and an acid/sugar solution, comprising: an acid treatment tank that receives a phenol derivative-impregnated lignocellulosic material, and is for adding an acid to bring about reaction; an aqueous dilution tank that receives a reaction mixture of the lignocellulosic material, the phenol derivative and the acid recovered from the acid treatment tank, and has means for putting in diluting water; a first solid-liquid separation apparatus that receives the diluted reaction mixture, and is for carrying out solid-liquid separation so as to separate off a lignophenol derivative as a solid phase; a second solid-liquid separation apparatus for further carrying out solid-liquid separation treatment on a liquid phase recovered from the first solid-liquid separation apparatus so as to separate out residual SS as a solid phase; an agitating tank that receives the solid matter recovered through the first solid-liquid separation, and is for adding water to the solid matter and agitating; and a third solid-liquid separation apparatus that receives an aqueous slurry recovered from the agitating tank, and is for carrying out solid-liquid separation.

[12]        An apparatus for recovering a lignophenol derivative and an acid/sugar solution, comprising: an acid treatment tank that receives a phenol derivative-impregnated lignocellulosic material, and is for adding an acid to bring about reaction; an aqueous dilution tank that receives a reaction mixture of the lignocellulosic material,

the phenol derivative and the acid recovered from the acid treatment tank, and has means for putting in diluting water; a first solid-liquid separation apparatus that receives the diluted reaction mixture, and is for carrying out solid-liquid separation so as to separate off a lignophenol derivative as a solid phase; a second solid-liquid separation apparatus for further carrying out solid-liquid separation treatment on a liquid phase recovered from the first solid-liquid separation apparatus so as to separate out residual SS as a solid phase; a crushing apparatus that receives the solid matter recovered through the first solid-liquid separation, and is for crushing the solid matter; an agitating tank for adding water to the crushed solid matter and agitating; and a third solid-liquid separation apparatus that receives an aqueous slurry recovered from the agitating tank, and is for carrying out solid-liquid separation.

[13] The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to claim 11 or 12, wherein the first solid-liquid separation apparatus and the third solid-liquid separation apparatus are constituted from the same apparatus.

[14] The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to any of claims 9 through 13, further comprising an agitating tank that receives solid matter recovered from the third solid-liquid separation apparatus, and is for adding water to the solid matter and agitating; and a fourth solid-liquid

separation apparatus that receives an aqueous slurry recovered from the agitating tank, and is for carrying out solid-liquid separation.

[15]        The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to any of claims 9 through 13, further comprising: a crushing apparatus that receives solid matter recovered from the third solid-liquid separation apparatus, and is for crushing the solid matter; an agitating tank for adding water to the crushed solid matter and agitating; and a fourth solid-liquid separation apparatus that receives an aqueous slurry recovered from the agitating tank, and is for carrying out solid-liquid separation.

[16]        The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to claim 14 or 15, wherein the first solid-liquid separation apparatus and the fourth solid-liquid separation apparatus are constituted from the same apparatus.

[17]        The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to claim 14 or 15, wherein the third solid-liquid separation apparatus and the fourth solid-liquid separation apparatus are constituted from the same apparatus.

[18]        The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to any of claims 14 through 17, further comprising means for supplying a liquid phase recovered from the third solid-liquid separation apparatus into the acid treatment/aqueous

dilution tank or the aqueous dilution tank as a diluting liquid.

[19]       The apparatus for recovering a lignophenol derivative and an acid/sugar solution according to any of  
5   claims 14 through 17, further comprising means for  
supplying a liquid phase recovered from the fourth solid-liquid separation apparatus into the acid treatment/aqueous dilution tank or the aqueous dilution tank as a diluting liquid.